

What is claimed is:

- 1 1. Cellulose fibers having a median desorption pressure, as determined in
2 a capillary absorption-desorption cycle, of 15 cm or less.
- 1 2. The cellulose fibers of claim 1, wherein the cellulose fibers have a
2 median desorption pressure of 14 cm or less.
- 1 3. The cellulose fibers of claim 1, wherein wherein the cellulose fibers
2 have a median desorption pressure of 13 cm or less.
- 1 4. The cellulose fibers of claim 1, wherein the cellulose fibers have a
2 median desorption pressure of 12 cm or less.
- 1 5. The cellulose fibers of claim 1, wherein the cellulose fibers have a
2 water retention value of 45 percent or less.
- 1 6. The cellulose fibers of claim 5, wherein the cellulose fibers have a
2 water retention value of 38 percent or less.
- 1 7. The cellulose fibers of claim 6, wherein the cellulose fibers have a
2 water retention value of 30 percent or less.
- 1 8. The cellulose fibers of claim 1, wherein the cellulose fibers are
2 crosslinked.
- 1 9. An acquisition and distribution layer comprising the cellulose fibers of
2 claim 1.
3
- 1 10. An acquisition layer comprising the cellulose fibers of claim 1.
- 1 11. A distribution layer comprising the cellulose fibers of claim 1.

1 12. An absorbent structure comprising:
2 (a) a top layer comprising cellulose fibers having a median
3 desorption pressure, as determined in a capillary absorption-desorption cycle, of 15 cm or
4 less; and
5 (b) a bottom layer comprising SAP particles, the second layer
6 being in fluid communication with the first layer.

1 13. The absorbent structure of claim 12, wherein the cellulose fibers have a
2 median desorption pressure of 14 cm or less.

1 14. The absorbent structure of claim 13, wherein the cellulose fibers have a
2 median desorption pressure of 13 cm or less.

1 15. The absorbent structure of claim 14, wherein the cellulose fibers have a
2 median desorption pressure of 12 cm or less.

1 16. The absorbent structure of claim 12, wherein the cellulose fibers have a
2 water retention value of 45 percent or less.

1 17. The absorbent structure of claim 16, wherein the cellulose fibers have a
2 water retention value of 38 percent or less.

1 18. The absorbent structure of claim 17, wherein the cellulose fibers have a
2 water retention value of 30 percent or less.

1 19. An absorbent structure comprising the cellulose fibers of claim 1.

1 20. An absorbent structure comprising the acquisition and distribution
2 layer of claim 9.

1 21. An absorbent structure comprising the acquisition layer of claim 10.

1 22. An absorbent structure comprising the distribution layer of claim 11.

1 23. A method for preparing cellulose fibers comprising the steps of:
 2 (a) refining cellulose fibers to a freeness of from about 300 to
 3 about 700 ml CSF; and
 4 (b) crosslinking the refined cellulose fibers.

1 24. The method of claim 23, wherein the cellulose fibers to be refined in
 2 step (a) are wet lap.

1 25. The method of claim 23, wherein step (a) comprises refining the
 2 cellulose fibers to a freeness of from about 500 to about 700 ml CSF.

1 26. The method of claim 25, wherein step (a) comprises refining the
 2 cellulose fibers to a freeness of from about 650 to about 700 ml CSF.

1 27. The method of claim 23, wherein step (b) comprises:
 2 (i) mixing the refined cellulose fibers with a crosslinking agent;
 3 and
 4 (ii) curing the cellulose fibers in the mixture.

1 28. The method of claim 23, wherein step (b) comprises:
 2 (i) mixing the refined cellulose fibers with a crosslinking agent;
 3 (ii) fluffing the cellulose fibers in the mixture; and
 4 (iii) curing the cellulose fibers in the mixture.

1 29. The method of claim 28, wherein step (b)(iii) comprises drying the
 2 cellulose fibers and curing the dried cellulose fibers.

1 30. The method of claim 28, wherein curing is performed at a temperature
 2 ranging from about 150 to about 175° C.

1 31. Cellulose fibers prepared by the method of claim 23.

1 32. A method of preparing an absorbent structure comprising

2 (a) preparing cellulose fibers by the method of claim 23; and

3 (b) incorporating the cellulose fibers into an absorbent structure.

1 33. Cellulose fibers crosslinked with at least one crosslinking agent selected
2 from saturated dicarboxylic acids, aromatic dicarboxylic acids, cycloalkyl dicarboxylic acids,
3 bifunctional monocarboxylic acids, and amine carboxylic acids and having a median
4 desorption pressure as measured in a capillary absorption-desorption cycle of 25 cm or less.

1 34. The cellulose fibers of claim 33, wherein the saturated dicarboxylic acid
2 has 2 to 8 carbon atoms.

1 35. The cellulose fibers of claim 34, wherein the saturated dicarboxylic acid
2 has 2 to 6 carbon atoms.

1 36. The cellulose fibers of claim 35, wherein the saturated dicarboxylic acid
2 has 2 to 4 carbon atoms.

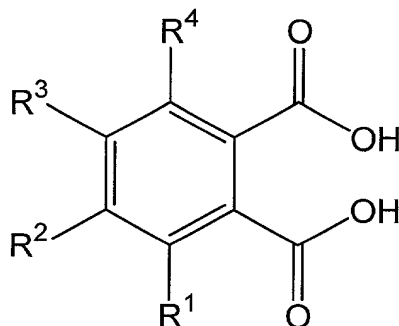
1 37. The cellulose fibers of claim 34, wherein the saturated dicarboxylic acid is
2 selected from oxalic acid, malonic acid, succinic acid, glutaric acid, adipic acid, pimelic acid,
3 suberic acid, and any combination of any of the foregoing.

1 38. The cellulose fibers of claim 33, wherein the saturated dicarboxylic acid is
2 a saturated hydroxy carboxylic acid.

1 39. The cellulose fibers of claim 38, wherein the saturated hydroxy carboxylic
2 acid has 2 to 8 carbon atoms.

1 40. The cellulose fibers of claim 39, wherein the hydroxy saturated
2 dicarboxylic acid is selected from glycolic acid, tartaric acid, malic acid, saccharic acid,
3 mucic acid, and any combination of any of the foregoing.

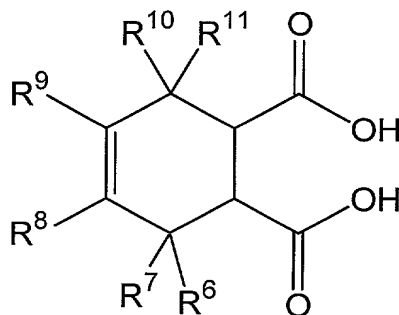
1 41. The cellulose fibers of claim 33, wherein the aromatic dicarboxylic acid
2 has the formula



11 wherein R¹, R², R³, and R⁴ independently are hydrogen, hydroxy, C₁-C₄ alkoxy, C₁-C₄ alkyl,
12 amino, halogen, or nitro.

1 42. The cellulose fibers of claim 41, wherein the aromatic dicarboxylic acid is
2 phthalic acid.

1 43. The cellulose fibers of claim 33, wherein the cycloalkyl dicarboxylic acid
2 has the formula



10 wherein

11 R⁶, R⁷, R¹⁰, and R¹¹ are independently hydrogen, hydroxy, halogen, C₁-C₄ alkoxy, C₁-
12 C₄ alkyl, amino, or nitro; and

13 R^8 and R^9 are independently hydrogen, halogen, C_1 - C_4 alkoxy, or C_1 - C_4 alkyl.

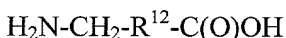
1 44. The cellulose fibers of claim 43, wherein the cycloalkyl dicarboxylic acid
2 is 1,2,5,6-tetrahydrophthalic acid.

1 45. The cellulose fibers of claim 33, wherein the bifunctional monocarboxylic
2 acid is selected from salts of a haloacetate, hydroxy monocarboxylic acids, acid derivatives of
3 hydroxy monocarboxylic acids, and any combination of any of the foregoing.

1 46. The cellulose fibers of claim 45, wherein the salt of a haloacetate is
2 sodium chloroacetate.

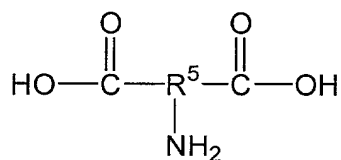
1 47. The cellulose fibers of claim 33, wherein the amine carboxylic acid is an
2 amino acid.

1 48. The cellulose fibers of claim 47, wherein the amino acid has the formula



5 wherein R^{12} is a bond, C_1 - C_{12} alkyl, or C_1 - C_{12} alkyl substituted with one or more of carboxyl,
6 hydroxy, C_1 - C_4 alkoxy, C_1 - C_4 alkyl, amino, and nitro.

1 49. The cellulose fibers of claim 47, wherein the amino acid has the formula



5 where R^5 is a linear or branched C_1 - C_8 alkyl.

1 50. The cellulose fibers of claim 49, wherein R^5 is a C_2 - C_4 alkyl.

1 60. The cellulose fibers of claim 33, wherein the cellulose fibers are derived
2 from wood pulp.

1 61. The cellulose fibers of claim 33, wherein the cellulose fibers have been
2 refined prior to crosslinking.

1 62. The cellulose fibers of claim 61, wherein the cellulose fibers have been
2 refined to a freeness of from about 300 to about 700 ml CSF prior to crosslinking.

1 63. The cellulose fibers of claim 62, wherein the cellulose fibers have been
2 refined to a freeness of from about 500 to about 700 ml CSF prior to crosslinking.

1 64. The cellulose fibers of claim 63, wherein the cellulose fibers have been
2 refined to a freeness of from about 650 to about 700 ml CSF prior to crosslinking.

1 65. The cellulose fibers of claim 33, wherein the cellulose fibers have been
2 cured at a temperature of from about 105 to about 225° C.

1 66. The cellulose fibers of claim 65, wherein the cellulose fibers have been
2 cured at a temperature of from about 150 to about 190° C.

1 67. The cellulose fibers of claim 66, wherein the cellulose fibers have been
2 cured at a temperature of from about 160 to about 175° C.

1 68. The cellulose fibers of claim 33, wherein the cellulose fibers have been
2 cured in the presence of a reducing agent.

1 69. The cellulose fibers of claim 68, wherein the reducing agent is a
2 hypophosphite.

1 70. The cellulose fibers of claim 69, wherein the reducing agent is sodium
2 hypophosphite.

1 71. The cellulose fibers of claim 33, wherein the water retention value of the
2 cellulose fibers is 50 percent or less.

1 72. The cellulose fibers of claim 71, wherein the water retention value of the
2 cellulose fibers is 45 percent or less.

1 73. The cellulose fibers of claim 72, wherein the water retention value of the
2 cellulose fibers is 38 percent or less.

1 74. The cellulose fibers of claim 73, wherein the water retention value of the
2 cellulose fibers is 30 percent or less.

1 75. The cellulose fibers of claim 33, wherein the median desorption pressure
2 of the cellulose fibers as measured in a capillary absorption-desorption cycle is 20 cm or less.

1 76. The cellulose fibers of claim 75, wherein the median desorption pressure
2 of the cellulose fibers as measured in a capillary absorption-desorption cycle is 18 cm or less.

1 77. The cellulose fibers of claim 76, wherein the median desorption pressure
2 of the cellulose fibers as measured in a capillary absorption-desorption cycle is 15 cm or less.

1 78. The cellulose fibers of claim 33, wherein the crosslinking is substantially
2 reversible.

1 79. The cellulose fibers of claim 33, wherein the crosslinking agent is oxalic
2 acid and the crosslinking is substantially reversible.

1 80. Uncrosslinked cellulose fibers prepared by uncrosslinking the cellulose
2 fibers of claim 33.

1 81. The uncrosslinked cellulose fibers of claim 80, wherein the crosslinking
2 agent contains 4 carbon atoms or less.

1 82. The uncrosslinked cellulose fibers of claim 81, wherein the crosslinking
2 agent is oxalic acid.

1 83. The uncrosslinked cellulose fibers of claim 81, wherein the crosslinking
2 agent is sodium chloroacetate.

1 84. The uncrosslinked cellulose fibers of claim 80, wherein the uncrosslinking
2 step comprises soaking the cellulose fibers in water.

1 85. The uncrosslinked cellulose fibers of claim 84, wherein the uncrosslinking
2 step comprises soaking the cellulose fibers in water for from about 0.5 to about 4 hours.

1 86. A sheet comprising the uncrosslinked cellulose fibers of claim 80.

1 87. An absorbent structure comprising the fibers of claim 33.

1 88. A method of preparing crosslinked cellulose fibers comprising intrafiber
2 crosslinking the cellulose fibers with at least one saturated dicarboxylic acid, aromatic
3 dicarboxylic acid, cycloalkyl dicarboxylic acid, bifunctional monocarboxylic acid, or amine
4 carboxylic acid.

1 89. The method of claim 88, wherein the saturated dicarboxylic acid has 2 to
2 8 carbon atoms.

1 90. The method of claim 89, wherein the saturated dicarboxylic acid has 2 to
2 6 atoms.

1 91. The method of claim 90, wherein the saturated dicarboxylic acid has 2 to
2 4 carbon atoms.

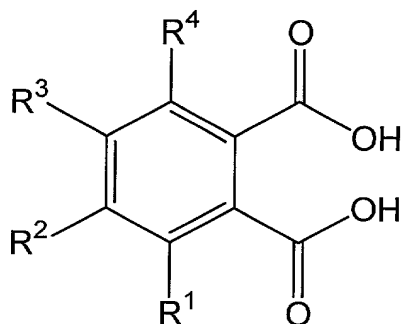
1 92. The method of claim 89, wherein the saturated dicarboxylic acid is
2 selected from oxalic acid, malonic acid, succinic acid, glutaric acid, adipic acid, pimelic acid,
3 suberic acid, and any combination of any of the foregoing.

1 93. The method of claim 88, wherein the saturated dicarboxylic acid is a
2 saturated hydroxy carboxylic acid.

1 94. The method of claim 93, wherein the saturated hydroxy carboxylic acid
2 has 2 to 8 carbon atoms.

1 95. The method of claim 94, wherein the C₂-C₈ hydroxy saturated
2 dicarboxylic acid is selected from glycolic acid, tartaric acid, malic acid, saccharic acid,
3 mucic acid, and any combination of any of the foregoing.

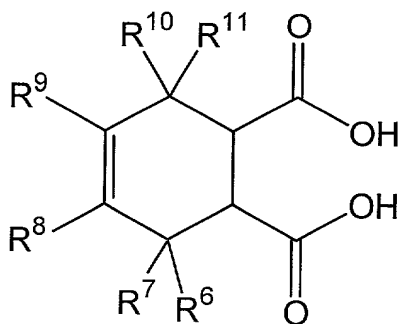
1 96. The method of claim 88, wherein the aromatic dicarboxylic acid has the
2 formula



10 wherein R¹, R², R³, and R⁴ independently are hydrogen, hydroxy, C₁-C₄ alkoxy, C₁-C₄ alkyl,
11 amino, halogen, or nitro.

1 97. The method of claim 96, wherein the aromatic dicarboxylic acid is
2 phthalic acid.

1 98. The method of claim 88, wherein the cycloalkyl dicarboxylic acid has the
2 formula



wherein

R^6 , R^7 , R^{10} , and R^{11} are independently hydrogen, hydroxy, halogen, C_1 - C_4 alkoxy, C_1 - C_4 alkyl, amino, or nitro; and

R^8 and R^9 are independently hydrogen, halogen, C_1 - C_4 alkoxy, or C_1 - C_4 alkyl.

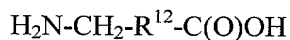
99. The method of claim 98, wherein the cycloalkyl dicarboxylic acid is 1,2,5,6-tetrahydrophthalic acid.

100. The method of claim 88, wherein the bifunctional monocarboxylic acid is selected from salts of a haloacetate, hydroxy monocarboxylic acids, acid derivatives of hydroxy monocarboxylic acids, and any combination of any of the foregoing.

101. The method of claim 100, wherein the salt of a haloacetate is sodium chloroacetate.

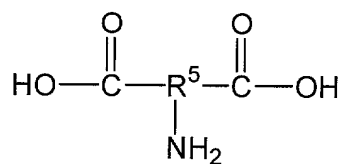
102. The method of claim 88, wherein the amine carboxylic acid is an amino acid.

103. The method of claim 102, wherein the amino acid has the formula



wherein R^{12} is a bond, C_1 - C_{12} alkyl, or C_1 - C_{12} alkyl substituted with one or more of carboxyl, hydroxy, C_1 - C_4 alkoxy, C_1 - C_4 alkyl, amino, and nitro.

104. The method of claim 102, wherein the amino acid has the formula



where R⁵ is a linear or branched C₁-C₈ alkyl.

105. The method of claim 104, wherein R⁵ is a C₂-C₄ alkyl.

106. The method of claim 102, wherein the amino acid is selected from aspartic acid, glutamic acid, and any combination of any of the foregoing.

107. The method of claim 88, wherein the amine carboxylic acid is ethylenedinitrilotetraacetic acid.

108. The method of claim 88, wherein the mole percent of crosslinking agent ranges from about 5 to about 21 mole percent, calculated on a cellulose anhydroglucose molar basis.

109. The method of claim 88, wherein the crosslinking step is performed in the presence of a crosslinking facilitator.

110. The method of claim 109, wherein the crosslinking agent is different than the crosslinking facilitator.

111. The method of claim 109, wherein the crosslinking facilitator is oxalic acid.

112. The method of claim 109, wherein the mole percent of crosslinking facilitator ranges from about 1.8 to about 9 mole percent, calculated on a cellulose anhydroglucose molar basis.

1 113. The method of claim 109, wherein the mole percent of crosslinking
2 agent and crosslinking facilitator ranges from about 0.05 to about 40, calculated on a
3 cellulose anhydroglucose molar basis.

1 114. The method of claim 113, wherein the mole percent of crosslinking
2 agent and crosslinking facilitator ranges from about 1 to about 30, calculated on a cellulose
3 anhydroglucose molar basis.

1 115. The method of claim 88, wherein the crosslinking step comprises:
2 (i) mixing the cellulose fibers with the crosslinking agent; and
3 (ii) curing the cellulose fibers in the mixture.

1 116. The method of claim 115, wherein the crosslinking step comprises:
2 (i) mixing the cellulose fibers with the crosslinking agent;
3 (ii) fluffing the cellulose fibers in the mixture; and
4 (iii) curing the cellulose fibers in the mixture.

1 117. The method of claim 116, wherein step (iii) comprises drying the
2 cellulose fibers and curing the dried cellulose fibers.

1 118. The method of claim 115, wherein curing is performed at a temperature
2 ranging from about 150 to about 175° C.

1 119. The cellulose fibers of claim 88, wherein the fibers are crosslinked in the
2 presence of a reducing agent.

1 120. The cellulose fibers of claim 119, wherein the reducing agent is a
2 hypophosphite.

1 121. The cellulose fibers of claim 120, wherein the reducing agent is sodium
2 hypophosphite.

1 122. The method of claim 88, wherein the cellulose fibers are refined prior to
2 the crosslinking step.

1 123. The method of claim 122, wherein the cellulose fibers are refined to a
2 freeness of from about 500 to about 700 ml CSF.

1 124. The method of claim 123, wherein the cellulose fibers are refined to a
2 freeness of from about 650 to about 700 ml CSF.

1 125. Cellulose fibers prepared by the method of claim 88.

1 126. A method of preparing uncrosslinked fibers comprising the steps of
2 intrafiber crosslinking cellulose fibers with at least one saturated dicarboxylic acid, aromatic
3 dicarboxylic acid, cycloalkyl dicarboxylic acid, bifunctional monocarboxylic acid, or amine
4 carboxylic acid; and uncrosslinking the crosslinked cellulose fibers.

1 127. The method of claim 126, wherein the crosslinking agent contains 4
2 carbon atoms or less.

1 128. The method of claim 127, wherein the crosslinking agent is oxalic acid.

1 129. The method of claim 127, wherein the crosslinking agent is sodium
2 chloroacetate.

1 130. The method of claim 126, wherein the uncrosslinking step comprises
2 soaking the crosslinked cellulose fibers in water.

1 131. The method of claim 130, wherein the uncrosslinking step comprises
2 soaking the crosslinked cellulose fibers in water for from about 0.5 to about 4 hours.

1 132. A method of preparing a sheet of uncrosslinked cellulose fibers
2 comprising the steps of preparing uncrosslinked cellulose fibers by the method of claim 126
3 and forming the uncrosslinked cellulose fibers into a sheet.

1 133. A method of preparing crosslinked cellulose fibers comprising the steps
2 of:
3 (a) preparing uncrosslinked cellulose fibers by the method of claim
4 126; and
5 (b) crosslinking the cellulose fibers.

1 134. A method of preparing an absorbent structure comprising
2 (a) preparing cellulose fibers by the method of claim 88; and
3 (b) incorporating the cellulose fibers into an absorbent structure.

1 135. An absorbent core comprising superabsorbent polymer particles and
2 reversible crosslinked cellulose fibers.

1 136. The absorbent core of claim 135, wherein the reversible crosslinked
2 cellulose fibers are crosslinked with oxalic acid, sodium chloroacetate, or a mixture thereof.

1 137. The absorbent core of claim 136, wherein the reversible crosslinked
2 cellulose fibers are crosslinked with oxalic acid.

1 138. The absorbent core of claim 135, wherein the absorbent core comprises
2 from about 30 to about 70% by weight of superabsorbent particles and from about 70 to about
3 30% by weight of reversible crosslinked fibers, based on 100% total weight of the absorbent
4 core.